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Outcome After Arthroscopic Capsular Release for Refractory Idiopathic Frozen Shoulder between Diabetic and Non-Diabetic Patients

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ABSTRACT

Background: This study evaluated the clinical outcome of the arthroscopic capsular release for refractory idiopathic frozen shoulder between diabetic and non-diabetic patients.

Patients and Methods: Between August 2020 and April 2022 a prospective study investigated thirty shoulders in 30 patients who had refractory primary frozen and undergone arthroscopic arthrolysis. Assessment was fulfilled using the Constant's shoulder score, Oxford shoulder score, visual analogue scale (VAS) for pain and measuring ranges of motion (ROM) at preoperative, six months postoperatively and at the final follow-up.

Results: There were 17 females and 13 males with a mean age of 47.8 (SD 7.5) years. The right shoulder was affected in ten patients and the other 20 had left frozen shoulder. Before surgery, the average time of frozen shoulder was 12.53 (SD 4.2) months. Diabetic patients constituted 56.6%, and mean follow-up was 12.33 (SD 2.9) months. Arthroscopy revealed subacromial adhesions in 73.3% and partial rotator cuff tears in 23%. The Constant's score, Oxford shoulder score, VAS for pain and ROM in all directions significantly increased at the final follow-up, compared to preoperative levels. There were statistically significant differences between diabetic and non-diabetic patients regarding postoperative flexion ROM, postoperative external rotation at 0° abduction, postoperative external rotation with abduction and postoperative internal rotation where non-diabetics showed better ROM and significant improvement in postoperative Constant shoulder score. The mean course of disease after surgery was 3.1 (SD 1.2) and complications represented 6.6%.

Conclusions: Arthroscopic release for refractory idiopathic frozen shoulder is an effective procedure. Better results are encountered in non-diabetic patients than diabetic counterparts.

Keywords: Arthroscopic, Release, Refractory, Frozen shoulder, Mansoura University.

INTRODUCTION

Frozen shoulder is a painful condition in which the movement of the shoulder becomes restricted. It influences the active and passive range of motion of the glenohumeral joint accompanied with debilitating pain. The prevalence rate of frozen shoulder is 2–5%, and it affects females more commonly in their sixth decade [(1,2)]. The expression "frozen shoulder" was developed by Codman in 1934. He described a gradual painful shoulder condition associated with stiffness and difficulty in sleeping on the affected shoulder. He also found that marked reduction in shoulder forward flexion and external rotation are the indicators of this disease. In 1945, the term "adhesive capsulitis" was used to describe frozen shoulder [(3)].

Even though its exact cause remains unclear, some factors escalate the risk of developing this disorder, including female gender, poorly controlled diabetes mellitus (DM), hyperlipidemia state, prolonged thyroid dysfunction, genetic predisposition, and Caucasian race [(4)].

Frozen shoulder is classified into either primary (idiopathic) or secondary. Secondary frozen shoulder can follow trauma, rotator cuff lesions, shoulder impingement syndromes, cardiovascular disorders and hemiparesis [(5)]. The cardinal pathology is marked synovitis and extensive fibroblastic proliferation resulting in contracture of the rotator interval capsule and ligaments [(6)]. Based on pain and stiffness, frozen shoulder can be broken up into three clinical stages: initially is the freezing stage (gradual onset of shoulder pain with increasing loss of motion), the frozen stage (gradual decrease of pain, increasing stiffness with equal active and passive ROM), and finally the thawing stage (gradual improvement of motion and settlement of symptoms) [(7)].

Although it has a self-limited course, recovery usually happens after 6 to 12 months. However, many patients can still report a prolonged period of shoulder pain , stiffness and disability [(8)]. Several conservative measures (physical therapy, anti-inflammatory drugs, and steroid intaarticular injections) are usually enough for pain settlement [(9, 10)].

Shoulder manipulation under anesthesia (MUA) [(11)], percutaneous hydrodilatation [(12)] and arthroscopic capsular release (ACR) [(13)] are indicated for refractory frozen shoulder when conservative measures fail. Although the long-term improvement in joint range of motion is similar with such techniques, performing (MUA) alone can lead to fractures especially with osteoporotic patients [(14)]. ACR holds multiple benefits as precise and selective release of contracted ligaments and capsule. On the other hand, radiofrequency utilization lessens postoperative hematoma, adhesions and delays capsular healing. ACR also decreases the

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risk of iatrogenic humeral fracture [8,15,16]. There are variations in literature regarding results after ACR for diabetic and non-diabetic patients where diabetics had inferior results [17,18], while other study showed no difference [19].

The aim of the present study was to evaluate the clinical outcome of the arthroscopic capsular release for refractory idiopathic frozen shoulder between diabetic and non-diabetic patients.

PATIENTS AND METHODS

Patient Population

Between August 2020 and April 2022, 31 patients with refractory frozen shoulder underwent arthroscopic release for refractory idiopathic frozen shoulder at orthopedic department at Mansoura university hospital. Other pathologies were excluded by plane X-ray and magnetic resonance imaging (MRI). Patients were older than 18 years, with refractory unilateral idiopathic frozen shoulders, who failed to improve after at least six months of conservative therapy were included.

Patients with complete rotator cuff tears, gleno-humeral arthrosis, inflammatory arthropathy, unenthusiastic patient to postoperative physiotherapy and shoulder stiffness secondary to trauma, radiation therapy & prior operation were excluded from our study.

One patient missed follow up after three months after operation, so eventually 30 patients were available for further follow up and statistical analysis.

Before surgery, assessment was performed using VAS for pain, Oxford Shoulder Score [20] and Constant shoulder score [21]. Subsequently, we measured the passive shoulder range of motion (abduction, forward flexion, extension, external at 0° abduction and with abduction, and internal rotation) in both normal and involved joints.

Ethical approval:

The study was accepted by the Ethical Committee of Mansoura University (Reference: MD.20.8.353) and an enlightened written consent was taken from every patient in this study for the acceptance of the operation. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Surgical Technique:

Patient Positioning and Arthroscopic Technique

Lateral decubitus positioning with hypotensive general anaesthesia is utilized (Fig. 1 A). During arthroscopy we use initially 1 mL of 1:1000 epinephrine dissolved in three liters of isotonic normal saline to decrease bleeding. The standard posterior portal is established first. A small incision is made 2 cm inferiorly and 2 cm medially to the posterolateral angle of the acromion process. Usually popping is felt as the joint is entered. Getting the trocar into the glenohumeral joint can be troublesome in patients with severe stiffness. Diagnostic arthroscopy is started initially. Exclusion of other pathologies such as rotator cuff tears. There is usually a tight glenohumeral space. There is often a reddish inflamed thickened contracted capsule at the rotator interval around biceps tendon (Fig. 1B).

The anterior portal is established by ‘outside in’ technique anterior to the long head of biceps tendon. Using Apollo RF MP90, Aspirating Ablator 90°, the anterior release is started with coracohumeral ligament release then superior glenohumeral ligament and anterior capsule then middle glenohumeral ligament descending to the antero-inferior capsule. Taking care not to harm the undersurface of the rotator cuff, the superior capsule is released just near the superior labrum (Fig. 1C, D, E).The superior capsule is released till visualization of the fleshy muscle fibers of the supraspinatus muscle (Fig. 1F).Then adhesions behind the subscapularis tendon are released by a shaver. Inferior capsule is left unviolated to save the axillary nerve from thermal injury. A switching stick is used to alternate between anterior and posterior portals. While viewing from anterior portal, the posterior and posterior-inferior capsule and glenohumeral ligaments are released successively (Fig. 1G). The viewing portal is alternated towards the subacromial compartment and the lateral portal is established to start subacromial decompression and bursectomy. After semicircular release is completed the shoulder is manipulated gently with forward flexion to 180 degrees, combined external and internal rotation to 180 degrees to confirm completed release. No inferior capsule release is performed in any case. An intra-articular catheter is inserted through the anterior portal to deliver 10 mL of bupivacaine injected immediately into the joint for postoperative pain relief and 5 ml of bupivacaine every 12 hours for five to seven days postoperatively to provide good analgesia for the patient to start passive and active assisted shoulder exercises (Fig. 1H).

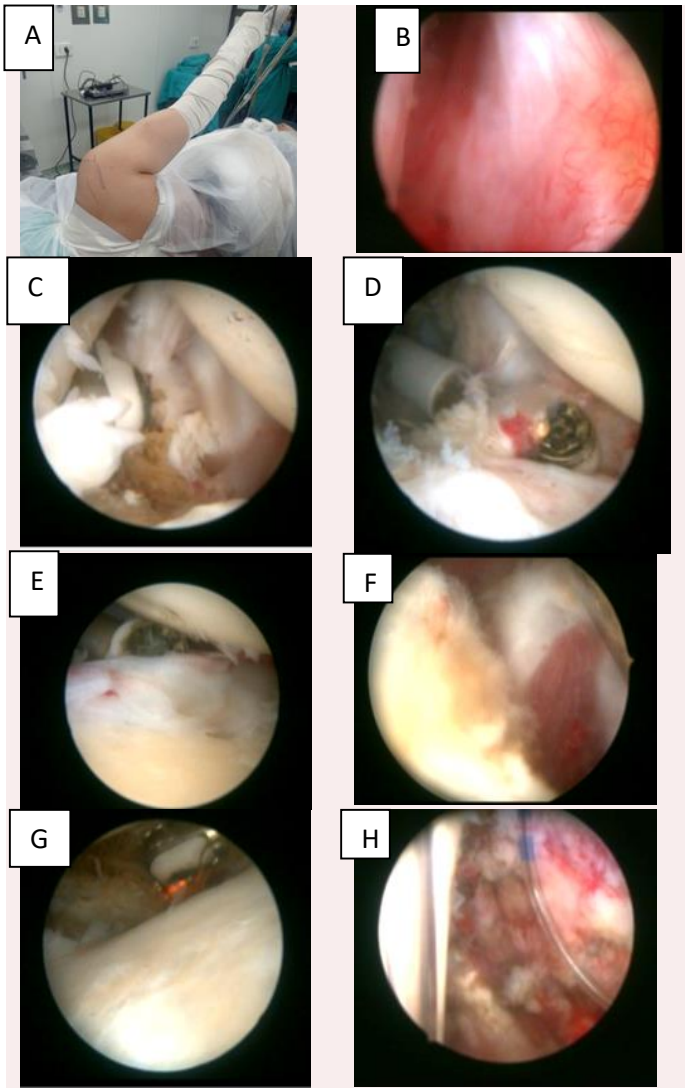

Figure (1): A). Working on the right shoulder using lateral decubitus with a traction. **B)**. Reddish inflamed glenohumeral capsule. **C)**.Releasing superior glenohumeral ligament and coracohumeral ligament. **D)**.Releasing middle glenohumeral ligament. **E)**.Releasing anteroinferior part of glenohumeral capsule near 5 oclock position. **F)**.Appearance of fleshy fibres of the supraspinatus after superior capsule release. **G)**.Posterior capsule release after swiching portals **H)**.Placement of intraarticular catheter for pain control.

Postoperative care:
A short course of narcotic analgesics is adopted to decrease postoperative pain and facilitate early passive range of motion in addition to 5ml local bupivacaine injection twice a day.

Rehabilitation:
First two weeks post-surgery: Passive, assisted-active exercises and leaning forward exercise are encouraged especially forward flexion and external rotation starting at the first postoperative day.

After 2 week of passive exercise, the patients start active exercise to strengthen the periscapular muscles.

After 4 to 6 weeks, the patients return back to usual work without any restrictions to routine daily activity. The rehabilitation program continues for 3 months post-surgery to obtain complete muscle strength of the shoulder girdle.

At six months and at twelve months evaluation will be done regarding range of motion, residual pain, function, VAS for pain, Oxford shoulder score [(20)]and Constant shoulder score[(21)].

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Wilk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) and Fisher's exact test to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean and standard deviation (SD). Independent samples t-test or Mann-Whitney U test was used to compare between two independent groups. All clinical results were compared sequentially between preoperative, 6 months postoperatively, and final follow-up by the Friedman test used for multiple comparisons of non-parametric data. P-value ≤ 0.05 was considered significant.

RESULTS

A total of 31 cases of primary frozen shoulder had undergone ACR by the same surgical team. One case lost follow up after three months postoperatively and was dropped from our statistics. The average age of the participants was 47.8 (SD 7.5) with minimum 38 and maximum 67 years old. 13 cases were males and 17 cases were females. The right shoulder was affected in 10 cases and the left shoulder was affected in 20 cases and all patients were right-handed. The mean follow up time in our study was 12.33 (SD 2.9) months with a minimum of twelve months. The mean time of preoperative suffering from frozen shoulder symptoms was 12.53 (SD 4.2) months with a minimum of six months before operation. Non diabetic patients were 13 (43.33%) and 17 (56.6%) of the patients were diabetic. The mean time of DM was 13.7 (SD 6.5) years of disease. Insulin dependent DM were 13 patients (76.47%) and oral hypoglycemic DM were 4 patients (23.52%). The mean HbA1c: 9 (SD 2) [Very poor control group ≥9%] constituted 8 cases which were 47% of the diabetic cases. The mean number of physiotherapy sessions postoperative was 18.5 (SD 9.4). We compared baseline characteristics of diabetic patients with those of non-diabetics and did not find any significant differences between the two groups (Table 1). Other comorbidities are mentioned in (Table 2). Previous contralateral frozen shoulder was found in 2 (6.66%) patients.

Table (1): Characteristics of diabetic and non-diabetic patients suffering from frozen shoulder

Variable		Diabetics	Non-diabetics	P-value
Number		17	13	0.7
Age		49.59 ± 7.3	45.62 ± 7.5	0.9
Sex	Female Male	9 8	8 5	0.72
Affected side	Right Left	5 12	5 8	0.7
Average duration of frozen shoulder before operation (months)	6:12 months 13:18 months 19:24 months	12 5 0	5 6 2	0.1
	IDDM NIDDM	13 4		
IDDM: insulin dependent diabetes mellitus NIDDM: non-insulin dependent diabetes mellitus				

Table (2): Associated comorbidities of participants.

Other comorbidities	Number	Percentage
DM	17	56.6%
HTN	11	36.7%
IHD	3	10.0%
Thyroid dysfunction	1	3.33%
DM: diabetes mellitus, HTN: hypertension, IHD: ischemic heart disease		

Arthroscopic intra-articular findings:

The usual findings of adhesive capsulitis as red synovitis with thick, fibrotic joint capsule were present in 27 (90%) cases and were classified as stage II adhesive capsulitis at arthroscopy [(22)] .

It was marked at the rotator interval and thickened capsule was felt during capsulotomy. Three (10%) cases were less hyperemic and inflamed but more thickened contracted capsule they were classified as stage III frozen shoulder [(22)].

Associated pathologies:

Eighty percent of the thirty cases had concomitant pathologies, the most common findings were degenerative tears at the insertion of long head of biceps in 23 (76%) patients; simple debridement was done. Subacromial adhesions were found in 22 (73%) patients, subacromial decompression was done, partial supraspinatus tears were found in 7 (23%) patients; they had debridement only as they were less than 25% of the thickness of the rotator cuff (Table 3).

Table (3): Summary of concomitant pathologies by arthroscopy and treatment

Variable	No. of shoulder	Treatment	Comments
Degenerative SLAP lesion or Tear of the LHBT	(23) 76%	Debridement or tenotomy of the LHBT	
Subacromial adhesions	(22) 73.3%	Subacromial space decompression	
Partial-thickness rotator cuff tear	(7) 23%	Tear Debridement	Less than 25% thickness 5 bursal Sided and 2 articular sided
No combined pathology	(6) 20%		
LHBT: long head of biceps tendon, SLAP: superior labral tear anterior to posterior			

Clinical results:

At 6 months postoperatively, the mean value of pain visual analogue scale (VAS) decreased by 6.1 and the Constant score increased by 46 and Oxford shoulder score increased by 18.5 as compared with preoperative levels. ROM also improved by 81.4° in forward elevation, 54.5° in external rotation, and 35° in internal rotation. According to the Constant-shoulder score, there were 5 excellent, 16 good, 8 fair and 1 poor outcome. All increases were statistically significant ($p<0.001$ for all variables) (Table 4).

At mean 12 months postoperatively, all clinical scores and ROMs were significantly increased compared to the preoperative measurements. Mean value of pain VAS decreased by 8, mean Constant score increased by 48.9, mean Oxford shoulder score increased by 26.17and the ROM improved by mean 88° in forward elevation, 72.5° in external rotation, and 39° in internal rotation. All increases were statistically significant ($p<0.001$ for all variables) (Table 4). According to the Constant-shoulder score, there were 21 excellent, 7 good, and 2 fair outcomes. There was a statistical significance in the mean preoperative pain VAS but, there was no statistical significance in the mean postoperative pain VAS between the diabetics and the non-diabetics ($p=0.01$* and $p=0.6$, respectively). There was no significant difference in preoperative Oxford shoulder score ($p=0.50$) and postoperative final mean Oxford shoulder score ($p=0.21$) between the diabetic group and the non-diabetic group.

There was no significant difference in preoperative mean Constant shoulder score ($p=0.62$), but there was a significant difference in final postoperative mean Constant shoulder score ($p=0.001$*) between the diabetic group and the non-diabetic groups. There were statistically significant differences between diabetic and non-diabetic patients regarding postoperative flexion ROM , postoperative external rotation 0°, postoperative external rotation with abduction and postoperative internal rotation where non-diabetics showed better ROM. Patient satisfaction mean (on a scale from one to ten) was 8.27 (SD 1.7) with a minimum of 3 represented by one (3.3%) case. There was no statistical significance between diabetic and non-diabetic patients (P-value 0.097).

Table (4): Summary of Clinical Scores and Ranges of Motion.

	Preoperative	**6th week**	**6th month**	**12 months**	**Significance**
Constant shoulder score	32.77 ± 4.3	55 ± 4.5	78 ± 8.3	81.67 ± 6.3	0.00**
Oxford shoulder score	11.53 ± 2.5	23 ± 5.3	30 ± 6.3	37.77 ± 6.02	0.00**
VAS for pain	8.10 ± 0.8	4.7 ± 0.7	2 ± 0.7	1.10 ± 0.41	0.00**
Forward Flexion	78.67 ± 16	158 ± 10.2	160 ± 11.3	166.7 ± 11.1	0.00**
Abduction	42.50 ± 9.41	125 ± 13.4	150 ± 13.4	155.67 ± 30.1	0.00**
External rotation +adduction	2.33 ± 0.48	40 ± 9.65	55 ± 10.2	69.83 ± 14.8	0.00**
External rotation +abduction	1.67 ± 0.31	41 ± 9.5	56 ± 12.2	74.17 ± 13.1	0.00**
Internal rotation +abduction	0.67 ± 0.12	20 ± 4.6	35 ± 8.4	39.67 ±8.5	0.00**

Complications:

Two (6.6%) cases had complications related to the operation; one (3.33%) patient had a transient infected anterior portal site that responded to antibiotics. The other case had recurrent frozen shoulder after six months and needed another session of arthroscopic release and aggressive physiotherapy .There was no deep joint infection or chondrolysis. There was no event of instability or dislocation. There was no nerve injury.

DISCUSSION

Although many clinical studies have failed to reveal the superiority of arthroscopic capsular release over MUA [23, 24], ACR has emerged as a better surgical alternative which provides controlled and specific release of fibrosed ligaments and capsule avoiding complications of MUA under the same anaesthetic burden [14]. Additionally, ACR enables the surgeon to thoroughly inspect and manage associated lesions which contribute to the pathology [25]. Our study included 30 cases who had shoulder arthroscopic semi circumferential capsular release leaving the inferior capsule intact to protect the axillary nerve followed by manipulation and temporary intra-articular catheter to deliver bupivacaine periodically to abolish pain and start early rehabilitation.

In this study, most of the patients with resistant frozen shoulder who failed at least six months of conservative treatment were female, with a mean age of 47.8 years old. Left shoulder was affected more frequently than the right side. About 56.6% of patients were diabetic, 47% of whom were very poorly controlled diabetes regarding HBA1c level. All of the thirty patients recovered from severe pain and achieved functional range of motion in less than four months. Shoulder range of motion and clinical outcomes improved significantly compared with preoperative level according to Constant, Oxford scores that were used for assessment; 93% of cases obtained an excellent or good result at an average one year of follow-up. Our overall results of arthroscopic capsular release at mean 12 months of follow-up are favorable and comparable to those former reports [26,27,28,29].

Regarding ROM in this study, all significantly improved from preoperative time to last follow as follow: internal rotation mean increased from 0.67° to 39.6°, external rotation at 0 abduction mean increased from 2.3°to 69.8°, external rotation with abduction mean increased from1.67° to 74.17°, abduction mean increased from 42.5° to 155.6°, forward flexion mean increased from 78.6° to 166.6° and extension mean increased from 13.5° to 41.5° at last follow up. Our results are coincident with other studies [26,27,28,29]. There was a significant difference between diabetic and non- diabetic patients in postoperative forward flexion, postoperative external rotation at 0° abduction, postoperative external rotation with abduction and postoperative internal rotation where the non-diabetic group showed a better improvement in range of motion [18]. It can be concluded that diabetic patients had a severe form of frozen shoulder [30]. They also experience more pain which decreases their capability to vigorously commence the exercises that are recommended [31].

The Constant shoulder score was 32 before surgery which is consistent with results of **Elhassan *et al.*** [26], **Ebrahimzadeh *et al.*** [32], **Yoo *et al.*** [27] **and Lafosse *et al.*** [28]. This score improved finally to a mean of 81.67 finally in our study, which is consistent with results from studies by **Elhassan *et al.*** [26], **Yoo *et al.*** [27] **and Lafosse *et al.*** [28] and **Ebrahimzadeh *et al.*** [32]. In our study, there was no significant difference in preoperative Constant shoulder score, but there was a significant difference in postoperative Constant shoulder score between the diabetic group and the non-diabetic groups as the non-diabetic patients had higher postoperative Constant shoulder scores.

Some studies showed that the results of arthroscopic capsular release for frozen shoulder in diabetic patients had less good results regarding postoperative Constant-Score [14,17,18].

Oxford shoulder score (OSS) mean was 11 before surgery which is consistent with results of **Smith *et al.*** [33] **and Ray *et al.*** [34].

This score improved to 37 postoperatively in our study, which is consistent with results from studies by **Smith *et al.*** [33] **and Ray *et al.*** [34]. There was no significant difference in preoperative Oxford shoulder score and postoperative Oxford shoulder score between the diabetic and the non-diabetic patients. Some studies also showed no significant difference in OSS between the diabetic and the non-diabetic patients [18, 33,34,35].

The difference between postoperative Constant score and OSS is mostly due to the inclusion of ROM in all planes as a component of the assessment in Constant shoulder score when compared to the Oxford shoulder score which focuses on pain and daily tasks.

Regarding shoulder pain, 90 % felt that their pain had been relieved significantly by the surgery after 3 months. Only 10% of the patients continued to have some pain requiring analgesics despite the surgery. Regarding visual analogue scale mean in this study, it was significantly reduced from preoperative time to last follow up from 8.1 to 1.1. So, the mean improvement in VAS scores was 7. Our result was consistent with **Ebrahimzadeh *et al.*** [32] study from 9.3 to 2.2, **Lafosse *et al.*** [28] from 7 to 1.6 and **Elhassan *et al.*** [26] from 7.5 to 1.

There was a statistical significant increase in mean preoperative pain VAS in diabetic patients in relation to non-diabetic counterparts, but there was no statistically significant difference in mean postoperative pain VAS between diabetic and non-diabetic patients in agreement with **Cinar *et al.*** [14] **and Lyhne *et al.*** [35].

Regarding complications after arthroscopic release represented 6.6% in our study. There were no

fractures, axillary nerve injury or instability after release.

Others reported no complications [28]. Complication rates reported in the literature, especially that involving axillary nerve injury, are extremely infrequent.

There were some limitations to our study. That is to say, lacking long term follow up and being a single center study.

CONCLUSION

Arthroscopic capsular release for refractory frozen shoulder is an effective procedure with a low complication rate. Better results are encountered in non-diabetic patients than diabetic counterparts. ACR enables the surgeon to comprehensively inspect and treat concomitant lesions.

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